

CENTER FOR BEAM PHYSICS SEMINAR

“Synchronization by Passage Through Resonances in Non-Neutral Plasmas”

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Albert Ghiorso Conference Room (71-264), LBNL
••• *Refreshments served at 10:20 AM* •••

Abstract: Magnetized, pure-electron plasmas in a Malmberg-Penning trap can be modeled by two-dimensional Euler's equations of ideal fluids. The plasma density and electric potential in this approximation are analogous to the vorticity and stream function of the fluid velocity field. For example, a uniform-density electron plasma cylinder in a guiding magnetic field is equivalent to a circular vortex patch solution of an ideal fluid. Other, uniform, shape preserving m-fold symmetric plasma/vortex equilibria (V-states) were discovered by Deem and Zabusky. Typically, creation of these states requires some very nontrivial initial conditions on the plasma boundary. I will describe a different, more realizable (in experiments and simulations) approach to creation of V-states. The idea is similar to that used in controlling nonlinear waves in other extended systems and can be called "Pattern Formation by Synchronization". In the present application, we start from a trivial (axisymmetric) uniform plasma equilibrium, but consider a perturbed problem, where the perturbation is an oscillatory driving potential of appropriate spatial symmetry. We chirp the frequency of oscillations of the driving perturbation and pass through a resonance with the initial plasma equilibrium. Then, under certain conditions, the driven system is captured into a persistent nonlinear resonance, yielding a new, nontrivial rotating plasma state. I will also describe emergence and stability of nonuniform V-states.

Biographical data and research interests: Lazar Friedland is currently a Professor at the Hebrew University of Jerusalem on sabbatical leave at UC Berkeley. His research interests include basic plasma theory, linear and nonlinear waves in space-time varying media, applications to resonances and mode conversion, pattern formation by adiabatic synchronization in dynamical and extended systems, non-equilibrium electron kinetics in plasmas, interaction of radiation and relativistic e-beams, and free electron lasers and accelerators.